State-of-the-Art

Life Cycle Management: UNEP-Workshop

Sharing Experiences on LCM

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Abstract. On August 30, 2001, the first in a series of planned global workshops on Life Cycle Management was organized in Copenhagen by UNEP in cooperation with dk-TEKNIK. The workshop provided an international forum to share experiences on LCM. The specific purpose of the workshop was to define the focus of a possible UNEP programme on Life Cycle Management under the UNEP/SETAC Life Cycle Initiative. Life Cycle Management has been defined by the SETAC Europe Working Group on LCM as an integrated framework of concepts, techniques and procedures to address environmental, economic, technological and social aspects of products and organizations to achieve continuous environmental improvement from a life cycle perspective. Life Cycle Management has been requested as an additional component for the Life Cycle Initiative by business organizations as well as governments in order to provide practical approaches for management systems in this area. The breakout groups of the workshop focussed on the role of integrating environmental management practices, concepts and tools in a life cycle perspective, on the integration of socio-economic aspects of sustainability in life cycle approaches, including the definition of adequate indicators for these aspects, on the communication strategies to promote life cycle thinking, and on the demand side of LCA. The workshop closed with a consensus that the UNEP/ SETAC Life Cycle Initiative should really include a programme on Life Cycle Management with the proposed areas of work. UNEP in cooperation with SETAC should function as a global catalyser of knowledge transfer and cooperation on life cycle approaches. The key issue behind all activities would be the promotion of Life Cycle Thinking since all break-out groups mentioned the importance of well-prepared communication strategies. Another interesting outcome of the workshop is the clear interest of different stakeholders in the consideration of social and institutional effects of products, in addition to environmental and economic impacts, i.e. a sustainable development perspective.

Keywords: Life cycle thinking; LCM; life cycle management; LCA; life cycle assessment; ISO 14040-series; DfE; design for environment; toolbox; sustainability; communications strategies

Introduction

In the Malmö Declaration of May 31, 2000, the Ministers of Environment who gathered at the first Global Ministerial Environment Forum stated, "Our efforts must be linked to the development of cleaner and more resource efficient technologies for a life-cycle economy". This follows-up on the 1999 revision of the 'UN Guidelines for Consumer Protection' that calls on governments together with industry to take into account the environmental impacts of goods and services through their entire life cycle. To foster the international efforts for a life-cycle economy UNEP joined forces with the Society of Environmental Toxicology and Chemistry (SETAC) last year to establish the 'Life Cycle Initiative'.

The Life Cycle Initiative began by elaborating and presenting a working programme on best practice in Life Cycle Assessment (LCA). The ambitious objectives of the LCA programme focusses on further LCA progresses by developing and implementing methods and data that correspond to an identified best practice in the field. Establishing guidelines and carrying out case studies will support these progresses. It will complement the ISO framework of standards and technical reports. Altogether, the LCA programme of the Life Cycle Initiative is aiming at:

- Harmonising existing bodies of LCA knowledge and stimulating multidisciplinary scientific work under the common roof of UNEP and SETAC;
- generating peer-reviewed, easy accessible Life Cycle Inventory databases and/or information systems with data on energy and raw materials used, as well as emissions, in order to facilitate the realisation of the Life Cycle Inventory Analysis and improve the reliability of its results;
- standardising and expanding applications of the impact assessment phase through the establishment of a best available Life Cycle Impact Assessment practice with adequate methods and factors;

- ensuring that LCA can be carried out worldwide for different types of applications and presenting corresponding case studies showing the successful application of the developed best practice.

UNEP and SETAC agreed to implement subprogrammes related to LCA on Life Cycle Inventory (LCI) and on Life Cycle Impact Assessment (LCIA) in order to achieve these goals. Feedback from the private sector as well as from developing countries and the user's community in general indicate that, in addition to the LCA programme, there is a need for a practice oriented product Life Cycle Management (LCM) Programme applicable also for small and medium-sized enterprises (SMEs), and including communication and dissemination/training plans. Inclusion of such a programme may be critical to the success of the Life Cycle Initiative. Especially, it seems that companies operating in different regions of the world would like to have an international framework in which they can develop their Life Cycle Management-related activities. This ties into UNEP's focus on Life Cycle Thinking, which is at the very core of UNEP's programme philosophy as a strategic conception and the global reach of their activities (UNEP 2001), which also does facilitate a more integrated approach.

Life Cycle Management has been defined by the SETAC Europe Working Group on LCM as "an integrated framework of concepts, techniques and procedures to address environmental, economic, technological and social aspects of products and organizations to achieve continuous environmental improvement from a life cycle perspective" (Hunkeler et al. 2001).

As the Life Cycle Initiative is an opportunity for UNEP to bring strategic Life Cycle Thinking to the attention of decision-makers' worldwide, while harmonising efforts and advancing the development of tools as practical steps towards a life cycle economy, the initiative was finally called an ambitious programme on approaches and best practice for a life-cycle economy. The objective of this initiative is now, "To develop and disseminate practical approaches for evaluating the opportunities, risks, and trade-offs associated with products over their whole life cycle to achieve more sustainable products".

This includes the generation, standardisation and integration of environmental information and approaches that facilitate Life Cycle Management activities. A further aim of this initiative is to bring Life Cycle Thinking to the attention of a global audience addressing governments, industry and organisations.

It is foreseen that after the start of the definition studies in the field of LCA, which are in preparation at the moment, the work on issues related to Life Cycle Management is to be initiated in a new programme. At the moment, UNEP and SETAC consider that the LCM programme could focus on the following key areas of interest to link Life Cycle Thinking with the environmental as well as social and economical aspects of sustainability for an adequate incorporation in management systems and a global dissemination:

1. Integration of environmental management practices, concepts and tools for supervising and decision-making in a chain management perspective on greener products and services
2. Consideration of socio-economic aspects of sustainability in a life-cycle perspective and develop set of adequate indicators for benchmarking
3. Strategies for the communication with stakeholders about life cycle product information

In the first area, it is considered that practical approaches be developed that allow a straightforward check on the environmental impacts of products and services, and that address the management of the environmental life cycle information along the product chain. The spotlight will be on flexibility, user-friendliness and applicability in SMEs and developing countries. Related to this, also the interaction and interfaces of various practices, concepts and tools to support development, procurement, production, sales and distribution of environmentally preferable products and services will be explored. The aim would be to define areas of application and to reach a certain integration of these approaches to make them consistent and to avoid contradictory results.

In the second area, an international process in which the socio-economic aspects of sustainability are more and more incorporated into a life-cycle perspective should be started. At the beginning, this work may consist of harmonising sustainability indicators developed by organisations like the UN Commission of Sustainable Development, OECD, Eurostat, EEA and others, and adapting life cycle approaches to also fulfil the requirement of developing countries. On the long-term, it would be good to promote a consistent framework of practices, concepts and tools, including a set of adequate indicators for benchmarking that allow applying the triple bottom line approach in a life cycle perspective and to incorporate this into management systems.

In the third area, the focus will be on the global relevance of Life Cycle Thinking. On the one hand, that includes communication strategies to make the (top) management of different types of companies interested in life cycle approaches by explaining them the adding value of using Life Cycle Thinking. On the other hand, it will consist of awareness campaigns aimed at consumers that are totally unfamiliar with holistic life cycle concepts to advocate sustainability. It is important to foster chain management and embedding this into product strategies and decision-making procedures. It is necessary to support capacity building in the area. Special attention will be paid to the enhancement and support of Life Cycle Thinking in SMEs and developing countries.

Clear deliverables of the LCM programme are expected to meet the target audiences' expectations and needs. Therefore, the basis for this programme must be carefully selected. It was proposed to start the programme with open workshops to identify drivers and needs of the user community. These workshops should include the private and the public sector; also small and medium sized companies should attend. The first workshop related to these topics was organ-

ized in Copenhagen on August 30, 2001 by UNEP in cooperation with dk-TEKNIK. A summary of the presentations, discussions and outcome of this workshop, to which nearly one hundred people assisted, is presented below.

1 Presentations

ANNE SOLGAARD of the United Nations Environment Programme made an introduction to the workshop and pointed out the high importance of worldwide dissemination and implementation of the Life Cycle Management programme to accomplish the objectives of the Life Cycle Initiative. UNEP is highly motivated to launch the Life Cycle Initiative with a LCM programme, as soon as sufficient resources to do so are available. Therefore, UNEP wants to get a sketch of different stakeholders targeting the demand side of the LCM and has accordingly prepared a short questionnaire that may be of interest:

a) Should the focus be on best practice or on approaches in the LCM programme? Do the three areas outlined correspond to the needs of the users?
b) How can simplified methods be accepted as sufficiently reliable?
c) To what extent are the socio-economic aspects of sustainable development to be considered?
d) What are the most efficient communication strategies of Life Cycle Thinking for what target group?

She concluded her talk adding that, although the Life Cycle Initiative is still in a very early stage, she expected that the initiative will grow in the next months, and that on the long-term their work will foster the development of tools for governments, business and consumers that translate life cycle thinking into practice. UNEP expects the following benefits of the whole Life Cycle Initiative, including the Life Cycle Management programme:

- Avoiding duplication of work and arbitrariness
- Providing reliable information in an accessible format
- Preparing industry for increasingly aware consumers
- Supporting good business practices
- Contributing to continuous improvement
- Ensuring global applicability and dissemination

HELIAS A. UDO DE HAES of the Centre for Environmental Studies (CML) at the Leiden University presented 'The demand side of the Life Cycle Initiative'. He pointed out the current dilemma in relation to LCM: On the one hand, there is a great need for structuring and upgrading LCM, but on the other hand, LCM is still a vague concept. He first identified possible deliverables from the Life Cycle Initiative. These were:

1. Methodology development of LCA, either full LCA (LCI and LCIA) or simplified methods
2. Methodology development of other quantitative environmental tools like Environmental Risk Assessment (ERA), Substance Flow Analysis (SFA) and Material Flow Accounting (MFA)
3. Methodology development of quantitative economic and social life cycle tools like Life Cycle Costing (LCC) and Input-Output Analysis (IOA)
4. Life Cycle Thinking, using qualitative criteria
5. The application of tools, including databases, software, case studies and guidelines concerned with when to use which tool
6. Communication and education
7. Company decision-making, including procedural tools and policy development

Next he introduced criteria for the inclusion of deliverables into an LCM programme. These criteria were:

a) Relevance for a life cycle approach
b) Additional to LCI and LCIA programmes
c) No overlap with other respected bodies
d) Suitable for identification of best practice (or, for LCM, possibly, good practice)
e) Fitting with tasks of UNEP and SETAC

On the basis of these criteria he concluded his presentation with suggestions for an LCM programme. This programme should, in his opinion, include the following deliverables:

- Life Cycle Thinking, using qualitative analysis
- Case studies as bridges with the other two programmes
- Guidelines as to when to use which tool
- Communication and education
- Further the LCM programme may possibly include the following deliverables:
- Simplified LCA methods, if good practice can be identified here, including validation by using full LCA methods
- Methodology development of economic and social tools, provided this does not take place elsewhere
- Guidelines on the use of procedural tools

KONRAD SAUR of Five Winds International, Germany, presented: 'The idea behind the UNEP/SETAC Life Cycle Management Programme'. He described the drivers for change: Consumers are supporting schemes that pressure manufacturers to design products with less environmental impact. In order to maintain or enhance the image of their brand, firms are driven to improve the environmental performance of their products, services and operations. The existing legislatorial framework also acts as a strong driver for firms to consider the environmental impacts of their operations, products and services.

A life cycle management approach is integrated in decision-making and operations at all levels of the organization, effectively in marketing, purchasing, research and development, product design, strategic planning, corporate reporting and management. Points of interest in the life cycle approach within the firm and the points where the firm feels external pressure can all be referred to as entry gates for life cycle management. He presented **Table 1** to introduce the product sustainability toolbox and proposed a list of goals of the Life Cycle Management Programme:

1. Make available Life Cycle Thinking, Life Cycle Economy and the 'Triple Bottom Line' approach practically available for organizations and in Management Systems
2. Demonstrate 'best practice' experience and implementation benchmarks as well as enables and barriers
3. Establish and document interaction, interfaces and integration of various existing tools, e.g. LCA, supply chain

Table 1: Product sustainability toolbox (Konrad Saur)

Applications	Tools
Environmental material, process and product comparison	EMS, Integrated management systems, Gap and SWOT analysis
Investment decision support	SD assessment
Strategic planning / Strategic decision support	Supply chain management
Marketing	Energy and substance flow analysis, assessment and optimization
Customer and regulatory compliance dialogue	LCI, LCA, Databases
Weak Point Analysis for environmental and economic improvements	Life cycle costing / Process cost, Total cost of ownership, Value creation assessment
Product and services benchmarking	Simulation of material and energy flows
	Design for environment

management and cost accounting for development of sustainable products
4. Agree on a useful toolbox for SMEs and developing countries to facilitate transfer of knowledge
5. Make visible the interfaces to Integrated Product Policies and decision-making, and cooperate with other existing efforts (Global reporting Initiative, Global Mining Initiative, Eco-Efficiency, emission trading/joint implementation, etc.)
6. Develop and promote communication programmes, including training and dissemination Modules for LCA and LCM seeking an integration with users ('language' problem of recipients) and stakeholders, including product declarations, labelling and green procurement
7. Use and positioning of procedural and analytical tools - toolbox
8. Consider social and ethical aspects, including work environment, in a life cycle perspective

His next step was to list what should be covered in a Life Cycle Management Programme: In respect to LCA development and application, he proposed looking at goal and scope dependency as well as at simplified-streamlining of LCA approaches. With regard to communication and education, he suggested the use of success stories and the develop of training courses. Then he advocated to link LCA to the larger environmental toolbox and to seek quantitative economic and social life cycle tools that allow one to integrate the triple bottom line of sustainability. Important questions to deal with are when to use which tool and how to integrate them. Finally, he recommended considering also the links to procedural tools and policy development. He finished his talk proposing different points on how to implement a Life Cycle management programme:

- Practice and result oriented: no ground research and driven by the user needs!
- Information integration for informed decisions, not tool integration
- Clear targets and deliverables (tools, reports, training modules), multi-disciplinary, no in-breeding
- Review and user feedback supported by web-based information gathering and workshops
- Teams work on specific themes with clear deliverables and timelines
- No replication of other work (GRI, Cleaner Production, EcoEfficiency) and dissemination of results

Ana Lorena Quiros of EcoGlobal in Costa Rica presented 'Towards Global LC Thinking'. She addressed the importance of adopting LCA and LCMs globally, particularly emphasising the urgent need for this knowledge in developing countries. She said that our aspiration is to have all stakeholders of every sector in all world regions introduced to the life cycle frame of thought. The challenge is how to bring Life Cycle Thinking 'global standing or stature', a challenge that appears to be more demanding for certain areas of the world. She stated that communication is key to everything that relates to Life Cycle Thinking. Therefore, at her company they have applied network thinking to identify and inoculate 'key vehicles' that foster propagation or greater expansion and coverage of particular ideas, concepts and applications. She suggested that we accept that multiple networks of power have composed society and thus, that we should focus on targeted networks in order to reach and implant the life cycle concept in different regions through the effective organization, control, logistics and communication capacity that such networks have across a given space and time. In certain countries, people seem to consider communication on environmental product attributes from independent environmental organizations to be the most reliable source of information. It would be of interest to reach the network of these organizations to implant Life Cycle Thinking.

On the other hand, building capacity in the development and adaptation of databases and procuring technological support should be oriented to networks such as those of higher education and scientific organizations. Business Managers could be reached through chamber and/or sector networking. In conclusion, target networks should be identified, communication strategies tailored to the targeted network(s) which have developed, 'inoculation' on the network should be performed and a cycle of feedback/ revision and expansion put in motion. **Fig. 1** illustrates such a process in a very simplified manner.

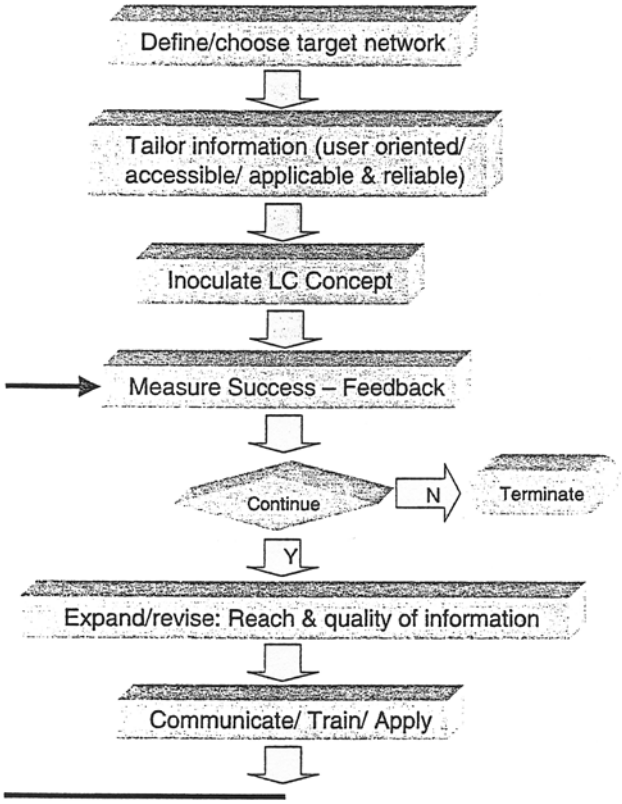

Fig. 1: Process towards Global Life Cycle Thinking' (Ana Quiros)

MARY ANN CURRAN of the US Environmental Protection Agency (EPA) talked about, 'Using Life Cycle Assessment Tools for Integrated Product Evaluation'. She pointed out that the European Union's newly suggested Integrated Product Policy directs governments and companies to consider the entire product life cycle, from cradle to grave, in their environmental decision-making process. A life cycle-based approach is intended to lead toward true environmental improvement and sustainability. However, the implementation of the life cycle approach in current practice follows two tracks: attribute-driven (i.e. assigning environmental goals at the outset) versus input/output driven (i.e. modelling environmental consequences from use and release data), which determine impacts after evaluating system flows.

She argued that there is a need to show that Life Cycle management is not an accounting tool, but a new framework for decision-making. LCA should be seen as one of several tools that are available to environmental managers and policy makers. She concluded that to truly reach integrated decision-making we need to take into account three different aspects: Product Performance (technical aspects), Life Cycle Assessment (environmental impacts) and Environmental Accounting (cost to business).

HENRY KING of Unilever presented his company perspective concerning 'Experiences and Needs of Life Cycle Management'. He explained Unilever's position in the food life cycle and knowledge attained from studies on food graphically. He pointed out that many impacts occur both upstream and downstream of their operations and, in order to achieve significant improvements and benefits for the environment, require both partnership with the supply chain (buyers/growers) and consumers awareness (marketing). He carried on presenting their Sustainable Agriculture Initiative based on three main points:

1. LCA methodology applied to each sustainable agriculture pilot crop/product (places agricultural stage in context with the rest of the supply chain)
2. Development of an approach to sustainability indicators and management strategies (Agricultural Best Practice Documents and Supplier selection criteria)
3. Industry sector collaboration.

Then he moved to present basic Life Cycle Management needs and argued that there is a need for tools/processes that are robust, accessible and targeted, that are complimentary/compatible with management practices, assist in multi-criteria decision-making while allowing for measurement and that can be used for communication. He added that data must be relevant and robust. He also noted that it is important that the UNEP/ SETAC Life Cycle Initiative provides a global strategy for Life Cycle thinking addressing LCA as a specific tool of the LCM toolbox in order to present an integrated approach for the fostering of more sustainable products and services. He finished his presentation discussing challenges and opportunities for the LCM programme: He asked if the programme should focus on environment or sustainable development aspects. He suggested exploring ways to build on existing business activities/management practices (environmental performance reporting, sustainable reporting and Global Reporting Initiative).

JO ROGERS of the American Institute of Chemical Engineers discussed the Total Cost Assessment (TCA) Methodology & Tools. TCA is a life cycle approach for internal corporate decision-making regarding alternative processes and products to ensure that all environmental and health costs are fully considered. Industry acceptance of this dynamic and emerging methodology is increasing. The interest of TCA lies in the hidden or miss-allocated, 'overhead' costs (e.g. Environment/Security/ Health (ESH), resource depletion, intangibles) that are often significant and becoming increasingly important. Drivers for TCA are compliance, stakeholder value, environmental stewardship, reduced insurance premiums, ISO 14001 certification and R&D decision-making. Rogers presented the CWRT TCA project divided into two parts: Survey of available methodologies worldwide, with the conclusion being that there is no methodology that meets industry needs; and development of industry validated methodology. The project team is composed of AD Little, DOE, Eastman Chemical, Georgia Pacific, Monsanto, Rohm and Haas, IPPC of Business Round Table, Bristol-Myers Squibb, Dow, Eastman Kodak, Merck, Owens Corning and SmithKline Beecham.

According to Rogers, economics of products & processes traditionally focus on direct costs. This is what he calls Type I costs. TCA considers Type I costs as well as indirect – non allocated corporate & plant indirect costs (Type II), future and contingent liability costs (Type III), intangible – internal costs (Type IV) and, finally, intangible – external costs (Type V). Rogers divides TCA into six main steps and a final feedback loop providing input into a company's decision process (Fig. 2). Rogers ended his talk presenting a new software tool (TCAce ™) that has been developed and is now being tested by collaborators.

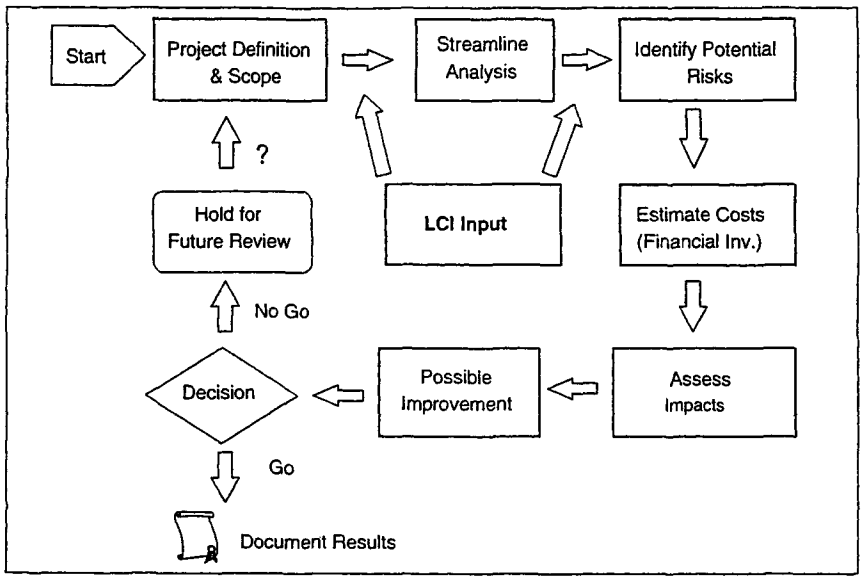

Fig. 2: Total cost assessment tool (Jo Rogers)

RON WILLIAMS of the GM Research and Development Center, USA, presented 'The Life Cycle View from General Motors'. Williams pointed out that the life cycle approach is used by General Motors on a global level in North America, Europe, the Asian Pacific region as well as Latin America. Around 50 man-years and several million US-$ are dedicated to research and development issues that concern life cycle questions. This work on Life Cycle Assessment and other life cycle methodologies, abbreviated by Williams as LCX, gains management attention and one of the main task of the people working on life cycle orientated projects is to communicate the life cycle concept within the company to increase the engineering awareness. Moreover, General Motors has established partnerships to further promote life cycle thinking in the society. General Motors uses LCX mainly to manage energy and environmental issues for different types of initiatives in public policy and marketing, as well as for purchasing decisions and marketing activities. The principal objective of General Motors' specific work in this field is to integrate emission and energy reduction strategies into a life cycle perspective as a basis for Design for Environment (DfE). However, Williams stated that the decision on what cars are finally produced is based on the market. Therefore, all programmes to bring low emission cars to the market place were postponed during the last year. On the road towards sustainability, the life cycle concept has an important potential role, although at the moment it is not clear what this role will actually look like. There are still a lot of knowledge gaps, and also the life cycle concept is limited and not able to support the decision-making on all problems related to sustainability.

AB STEVELS of Philips Consumer Electronics, the Netherlands, presented 'Product environmental care systems built up from the implementation perspective – Life Cycle Management at Philips Consumer Electronics'. He started his presentation with a graphical representation of an environmental value chain of the electronics industry (Fig. 3).

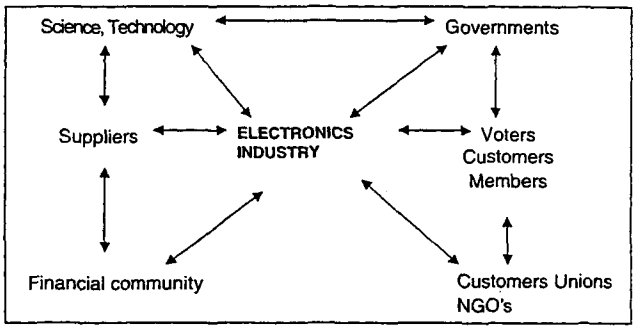

Fig. 3: An environmental value chain of the electronics industry (Ab Stevels)

Then he presented the three types of green:

1. Scientific green: Life Cycle analysis has so far focussed on emissions.
2. Government green: Focus on recycling and potential toxicity, but does it focus on energy?
3. Green perceptions: Focus on substances which are natural.
4. Furthermore, he stated that three different environmental perspectives exist:
5. The emission perspective (e.g. SO_2 emission versus heavy metal emission)
6. The resource perspective: depletion and grade/entropy (e.g. coal versus natural gas)
7. The (potential) toxicity perspective (e.g. different chemical forms of lead)

Stevels carried on his talk introducing a generic model of integrating environmental aspects into the product development process based in six different stages that correlate with six different actions to be taken within the stages. Thus, planning is considered to be the first stage and the first action will be to get facts, prioritise according to benefits and feasibility, align with company strategy, and consider environmental as well as life cycle aspects. The next step (stage 2) is the conceptual design, with active brainstorming, life cycle screening and transformation into specifications. Stage 3, detailed design, consists of applying design approaches, and stage 4, testing a pro-

totype, means evaluating the results against established targets and the specifications. Market launch is stage 5 and comprehends release and communication plans, while the consideration of environmental aspects and effects is the action to be taken in the last stage (stage 6), entitled product review.

He presented a list of experiences so far from a teaching perspective. These experiences include the fact that environment is much more than a couple of technical solutions and that you have to keep it simple. There is a need to put activities in a value-clear perspective. Necessary elements are empowerment and you have to speak the language of the stakeholders if you want to change something. He concluded that the experiences of the successful greening of the business at Philips is worth sharing with others, that environmental benchmark is the technical basis and that the drivers have to be taken into account.

OTTO LINHER of the DG Environment at the European Commission presented 'The interest of the European Commission in the Life Cycle Initiative'. Linher expressed strong support to the UNEP/SETAC Life Cycle Initiative and mentioned that LCA and LCM provides the yardstick to measure environmental performance. The commissions' initiative on Integrated Product Policy (IPP) builds on this idea in providing the policy framework for Life Cycle Thinking. He then discussed the relation of LCA and LCM to IPP. According to Linher, LCA and LCM are part of IPP, where LCM is much broader than LCA. However, LCM is mainly an industry question and not so much a topic for governments. At the moment, the work of the European Commission on these issues is oriented towards the environmental aspects of sustainability, but not on the triple bottom-line approach of sustainability, including socio-economic aspects. For Linher, the drivers for life cycle activities are: Money saving, market place, consumer vision and policy requirements. The work of government authorities is limited to areas where value can be added to the ongoing activities of other stakeholders. All government activities should be carried out in a coordinated way to avoid the duplication of work. Linher identified the following areas where action is needed:

- Development of simple and practical tools for SMEs
- Identification of high quality data
- Linkage of database resources that exit in different sources on a European and international level
- Enhancement of information exchange
- Facilitation of easy access to data

The role of UNEP within these activities is clearly to give an international forum for information exchange and to facilitate the data flow on a global level, including the developing countries.

2 Group Discussions

A summary of the issues discussed within the small breakout groups and then during a moderated discussion session is presented below.

2.1 Integration of environmental management tools

Adequate expertise is essential to carry out a complete life cycle management programme. Thus, multidisciplinary and relevant experts from different areas of knowledge such as the social field, economics, etc. are needed. Broad participation is required to understand the needs of the users of life cycle methods. As groups of interest have been identified: industry (both large organizations and SMEs), governments/administrations (from developed and developing economies), consumers, academia, as well as consultants. Needs assessment may identify additional requirements, including partnerships. When doing this, it has to be taken into account that the world's different cultural backgrounds may require differentiated approaches and that communication is essential for all phases of an LCM programme. In the same direction, a necessity was seen to identify and group different drivers opposite different interest groups and cultural backgrounds. The following structural elements were found:

- Regions: Europe, NA, South and Latin America, Africa, Asia-Pacific
- Types: private, public, NGO, academia
- Economic scale: large multinational, SME, non-profit.
- Information needs: depending on position in value chain.

On the issue of which environmental tools are of interest in a life cycle perspective and what their respective area of application is, the members of the discussion group agreed that all tools are of potential interest, but that there is still work to do in order to position the different tools, recommend their respective use opposite needs, drivers and position of the interest group. Toolboxes should be developed describing tools with respect to their level of usefulness in certain applications, as well as with respect to barriers and successes in implementation. It seems that the main target now is to add environmental tools to the existing practice (both analytical and procedure tools were considered to be of interest), not to reinvent current practice or try to alter them since there is too much resistance for large changes. Incentives for changes must be clear so that the existing tools may be tailored for practical use. Participants agreed that tools should be positioned for multiple users: public or private, consumers, etc., and that emphasis should be on an integration of information to better support decision-making processes. However, the work should not only be on tool integration, but also on alignment and positioning. Moreover, the participants stated that no new tools should be developed as a target if there is not a clear need for them. It was agreed that a survey may identify gaps and user needs and respectively stimulate tool development where needed. Communication was seen as the most important tool currently.

Best practice was recognized as dependent on structural, cultural, sectorial, geographical and market circumstances and positioning. Comments were on the line that best practice is difficult, as practice constantly emerges. In addition, best practice may be sector or value chain-positioning dependent. There was a general agreement that the next work to do was to define sectorial programmes. The next issue discussed was related to simplification and how simplified methods could be accepted to be sufficiently reliable. It is a fact that simplification is essential for industrial practice and that it must be based on relevant and reliable criteria. Taking into consideration that time to decision is a critical success factor today, simplification is almost a need. On the other hand, it is also essential to understand the risks of simplifications and that they mainly depend on the aims and targets to be achieved, and thus on

the specific circumstances (i.e. meet corporate reduction targets). Participants agreed that experiences and lessons should be shared and proposed some ways to do it: workshops, seminars and symposia; web-based exchange information; case studies (simple format); training programmes and modules, including feedback loops, for different audiences, especially to educate and train decision-makers; reports and other dissemination activities. Therefore, professional writers and communicators must be involved and communication with the stakeholders is considered to be essential.

Decision-making, planning and green reporting are considered communication tools that require action on. Environmental product declarations and eco-labels are product sector specific applications; altogether outside of the core LCM applications, however interfaces should be discussed, because they may be drivers for LCM and, as such, the response to those drivers should be included in any LCM programme. Finally, it was concluded that the LCM programme should develop answers on the issues raised. Today even, no final definitions exist on a terminology that satisfies all needs. However, the results of the SETAC Working Group on LCM are probably the best starting point.

2.2 Consideration of socio-economic aspects of sustainability in a life-cycle perspective

The participants of this discussion group agreed that socio-economic aspects should actually be taken into account in the Life Cycle Initiative, but questioned as to how it should be done. Finally they suggested, in principle, that socio-economic issues should not only be considered in the LCM programme, but should also be integrated into the subprogrammes for LCI and LCIA. System boundaries do not differ from environmental to social parameters; therefore, there is no need to reinvent the wheel. For example, with the indicator Years of Life Lost (YOLL) and the use of external costs in the evaluation of environmental impacts, socio-economic aspects have already been addressed in the LCA framework. By using the same approach as used for an environmental LCA, the workload could be reduced. Besides, social risk analysis can help to make a checklist for companies' products. Here some participants identified a tension between the checklist approach and an elaborated impact assessment science and requested that one be aware of the different types of approach. A checklist continues to be considered more practical, but they can always feed on each other. Participants agreed that activities that are occurring in the social area are less developed than those in the economic and especially in the environmental area. A need has been identified by the participants to additionally take culture into consideration and to also work in the environment with the influence of work conditions on the quality of life, which are perceived as more or less important depending on the country.

In general, the Life Cycle Initiative has to be aware of different drivers, such as sustainability reporting, which includes social issues, but is usually not very well developed in the present reports. Here, LCM relates to other initiatives, especially the Global Reporting Initiative (GRI) active in the field of social indicators, including fair trade, labour practices (health and safety), child labour and human rights (important for developing countries), community and society issues, as well as quality and guaranteed minimum salaries of the employees. Many of the social indicators are country-related; most of the focus at the level of companies until now has been to integrate social issues into procurement strategies. The participants made clear that the Life Cycle Initiative should not make health issues the bottom line for quality of life, because there are some social criteria that need to be distinguished and to be taken into consideration as well. On the economic side, the LCM programme should be aware of an international system of environmental accounts, based on the national accounting systems, and on an environmental accounting network, where work is going on issues that link financial and management activities with environmental accounts. Also UNEP is active in that field with its Finance Initiatives. At the end, the group is evaluated in which way experiences and lessons learned could best be shared. The participants mentioned the work being done in Japan to develop social indicators. Other experiences exist based on the activities done at the OECD and within different UN organizations. The discussion group concluded with the following actions to be undertaken:

- Identify where work is already going on (mainly at the level of governments and companies).
- Work, with UNEP as a catalyst, in the creation of a programme that addresses the socio-economic aspects together with environmental impacts in the product and service development.
- Promote the integrated consideration of social, economic and environmental issues in a life-cycle perspective.
- Establish life cycle management practices and approaches for integrating social, economic and environmental issues.

2.3 Communication strategies

The participants of this breakout group discussed first who are the target groups for communication strategies. They agreed that the breakout groups could basically be divided into experts, non-experts, internal (involved in any LCM project) or external. Currently, the dissemination activities are basically focussed on people working on environment, health and safety issues in industry and governments, and that mainly belong to the engineering field. Next, it was discussed whether there exists one holistic communication strategy; finally it was said that this would not be possible since messages in LCM have to be audience specific and always depend on the feedback received. However, some basic principles consistent at all levels actually exist that must be communicated to all audiences. Main issues to communicate in relation with LCM will be the benefits of LCM application and the knowledge gained thanks to all the interaction compiled on the use of life cycle tools. Green Reporting, Environmental Product Declarations and Eco-labels were considered to be ways of communication. However, they have to be considered separately case-by-case because of the great importance of the regional differences.

Experiences and prepared education documents should be shared worldwide in different ways: literature on the field, publication of surveys, LCA/LCM conferences and communication of industry experiences. Communication should happen both web-based and face-to-face. The idea of developing a clearinghouse was expressed. According to UNEP's experi-

ence on the dissemination of their work in the programmes on Cleaner Production, conditions vary enormously from country to country so that the communication of experiences and education documents should be done by tailoring the information mostly from one country to another, and sector by sector. Another way of creating capacity was proposed by asking the industry (and governments) to offer internships to interested persons, especially from developing countries, in departments that use the life cycle approach. More and more people should have the opportunity to learn from those already working with it. Finally, also demonstration studies should be used for education purposes, e.g. a success story of 3M or an example from Malaysia. The group concluded with recommendations of a number of actions that should be carried out: First of all it should be checked what currently exists on training courses, education material, demonstration studies, etc.; then a set of overreaching principles for the communication strategies should be developed: as a next step, people that understand communication should be engaged; and finally a global communication strategy should be applied, using the network approach as a basis.

2.4 Demand side of LCA: Needs for improvement

In addition to the groups on LCM, the discussions in one group mainly focussed on the current needs for improvement of the LCA practice. Clear deliverables for the subprogrammes on LCI and LCIA have been proposed by UNEP and SETAC (UNEP/ SETAC 2001). The workshop served here to get a feedback of the user community on the current working proposal. There was an agreement that there is a need to fill in gaps left by the ISO 14040 series. However, it was suggested to focus on simple methods and to promote such thinking among the suppliers of life cycle tools. Another general remark was to improve the involvement of developing countries. Flexibility and prioritisation is needed for the projects that will go on under the authority of the LCI and LCIA subprogrammes due to the heavy workload foreseen. With regard to the idea of establishing 'best practice' on LCA within the Life Cycle Initiative it was said that it might be better to aim for 'recommended practice'.

The main problems for the Life Cycle Inventory subprogramme were seen in the availability of high quality. Therefore, it was recommended by some participants to identify first bottlenecks and to then focus on a free database under UNEP/SETAC limited to background processes. UNEP and SETAC were asked to also include quality tests in the Life Cycle Impact Assessment subprogramme. The participants saw the Life Cycle Initiative as a general framework for identifying the main gaps, focussing research and fostering development programmes around the world. Main action points for the LCIA subprogramme would be to complete a consistent list of midpoint categories and indicators, which include the categories for developing countries disregarded until now. Finally, case studies were considered to be essential for the Life Cycle Initiative. They should provide a practical check of the feasibility, validity and relevance in decision-making of the initiative's results and would also have an educational value, in particular for developing countries.

2.5 Relation to Integrated Product Policy

The participants of all groups were asked to give their opinion whether LCM is a system, a concept or a toolbox and about the relation of LCM to Integrated Product Policy. Most of them argued that LCM could be a concept or a toolbox; however, it could be called a managerial concept for implementation. In comparison to LCM, IPP is considered to be much wider, although it has not yet been well defined, and in addition IPP is only a European activity until now. Nevertheless, IPP is seen as an important driver that should be closely watched. IPP can be viewed as an umbrella for product-oriented governmental initiatives (regulation, funding, international agreements, etc.), whereas LCM is the umbrella in the individual company or organization for product-oriented environmental management and the relations to other aspects of sustainability.

3 Conclusions

The main conclusion of this workshop was that the UNEP/ SETAC Life Cycle Initiative should really include a programme on Life Cycle Management with the proposed areas of work: integrating environmental management practices, concepts and tools; socio-economic aspects of sustainability; and communication strategies. UNEP in cooperation with SETAC is an adequate forum to share experiences of different stakeholders in the field of LCM and can function as a global catalyzer of knowledge transfer on life cycle approaches. The key issue behind all activities has to be the promotion of Life Cycle Thinking. All break out groups have mentioned the importance of well-prepared training and education activities and communication programmes for different stakeholders.

Moreover, among the recommendations highlighted, it was stated that the Life Cycle Initiative should facilitate demonstration studies and guidelines related to life cycle approaches, in order to foster better environmental management that can be adopted to various sectors and regions (in particular developing countries). The social and economic aspects should also be considered in the LCA programme. Finally, it was asked for the identification of adequate indicators on environmental, economic and social issues in a life-cycle perspective and for the creation of a global network of interested parties.

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